ISSN 0840-8440

PROCEEDINGS

TECHNOLOGY TRANSFER CONFERENCE 1988

November 28 and 29, 1988

Royal York Hotel

Toronto, Ontario

SESSION B

WATER QUALITY RESEARCH

Sponsored by

Research and Technology Branch

Environment Ontario

Ontario, Canada

AA54

BP5

THE ONTARIO INLAND LAKES PROGRAM AND MANAGEMENT OF BLUE-GREEN ALGAE: THREE WHOLE LAKE TREATMENTS IN 1988

H. Vandermeulen and K.H. Nicholls
Ontario Ministry of the Environment, Water Resources Branch,
Box 213, Rexdale, Ontario, Canada M9W 5L1

INTRODUCTION

While Ontario's phosphorus control program has achieved measurable reductions in blue-green algal blooms in some inland lakes, there exist many other surface waters for which conventional nutrient loading controls are not practical. One of the objectives of the inland lakes program is to apply other methods to control excessive growths of blue-green algae in eutrophic lakes and reservoirs in Ontario. We are using the "whole lake" approach to accomplish this task. Three different projects were initiated during the summer of 1988, destratification using a Garton style propeller with an upwelling tube at Guelph Lake, hypolimnetic aeration at a small kettle lake in London and a calcium carbonate addition to Puslinch Lake near Cambridge.

METHODS

Destratification - In late September 1988 a 6 m X 6 m raft of welded angle iron with a wire grid deck and ten 230 litre metal drums for floatation was anchored over one of the deepest sections of Guelph Lake. A 4 m long (3.5 m diameter) tube constructed of 2 mm thick polystyrene sheets was attached vertically to the raft 2 m from the lake surface. A metal framework reinforced by guy wires was used to suspend a propeller driven by a submersible electric motor inside the tube, 1 m from the top. The propeller system (Flygt Canada, model 4410 Flomaker) utilized a 3.2 HP motor (600 Volt, three phase) with attached gearbox producing a propeller speed of 32.3 RPM. The propeller was 2.2 m in diameter and used "Banana" style blades which were designed to produce a flow rate of 2.9 m^3 / s. The motor was

connected to an electrical supply within the Guelph Lake dam via a 250 m long submersible SOW cable. The destratification system was designed to move bottom water up to the surface of the lake for gas exchange. The system will be removed each winter for storage.

Hypolimnetic Aeration - In early October 1988 a 6.1 m X 2.5 m raft of welded angle iron with a plywood deck and ten 230 litre metal drums for floatation was anchored over the deepest section of a kettle lake in London. A 5.5 m X 1.8 m X 0.6 m deep mixing box constructed of 1.6 mm polystyrene sheets was placed inside the raft and covered by styrofoam SM R10 insulation (10 cm thick on sides, 15 cm thick on bottom). Nine PVC pipes (1.3 cm diameter, 1.8 m long, with 1 mm diameter holes drilled every 2.5 cm) were laid across the bottom of the mixing chamber at 0.5 m intervals. Baffles were placed between the pipes. The pipes were connected to a 0.75 HP oilless compressor (240 volt, three phase, 2 SCFM, 100 PSI) bolted to the deck of the raft. An 8 m long (38 cm diameter) polystyrene inflow tube was attached vertically to one end of the mixing box. A 7 m long (46 cm diameter) polystyrene outflow tube was attached vertically to the other end of the mixing box. The end of the outflow tube was angled to discharge water away from the raft. A metal framework was used to suspend a propeller driven by a submersible electric motor inside the inflow tube, 30 cm from the top. The propeller system (Flygt Canada, model 4400) utilized a 1.5 HP motor (240 Volt, three phase) producing a propeller speed of 1130 RPM. The propeller was 22 cm in diameter and was designed to produce a flow rate of 0.1 m^3 / s. The compressor and propeller motor were connected to a domestic electrical supply (Rotophase converter used to change single phase to three phase) at the lake shore via a 200 m long submersible SOW cable. The propeller pulled water up from the hypolimnion into the mixing box were air supplied via the PVC pipes agitated the water and baffles forced it along a circuitous path to enhance gas exchange. The oxygenated water was returned to the hypolimnion by gravity via the outfow pipe. The system will be removed each winter for storage.

Calcium Carbonate Addition - In early September 1988, powdered limestone (96% $CaCO_3$, 80% of particles <45 um) was brought to Puslinch Lake via tanker truck and blown into the hold of a specially designed trimaran vessel. The vessel had a computerized pumping system to take on lake water and mix it with the powder in the hold. The resulting slurry was deposited on the surface of the lake via spray arms attached to the stern of the vessel covering a width of 18 m. Most areas of the lake deeper than 1 m were sprayed in this manner. A total of 76 metric tonnes of limestone powder was applied within three days.

DISCUSSION

The destratification of a portion of Guelph lake will continue during the summer of 1989. The testing of this system during September 1988 indicated that it does function but the size of the effected area of the lake needs to be determined. It is hoped that destratification will reduce the severity of blue-green algal blooms in the lake as has been reported by other authors. Destratification can prevent an anoxic hypolimnion from forming. Anoxic conditions in bottom waters during the summer months encourages sediment release of nutrients and metal ions, a phenomenon which is correlated with (drives?) the onset of blue-green blooms.

The testing of the hypolimnetic aeration system in the kettle lake has not been completed at the time of writing. The system will be run during the ice free period of 1989 to determine its effect upon the lake and blue-green algae. Hypolimnetic aeration is also expected to prevent sediment release of nutrients, it differs from destratification in that the hypolimnion is preserved. The bottom waters can then be used for maintaining a cold water fishery in a lake were low oxygen levels previously prevented its establishment.

The addition of calcium carbonate to Puslinch Lake should not have a measurable effect upon the lake until the summer of 1989. Slow dissolution of the calcium carbonate during the winter of 1988 will release calcium ions which will bind with phosphorus and lead to a low concentration of this nutrient. Warm water